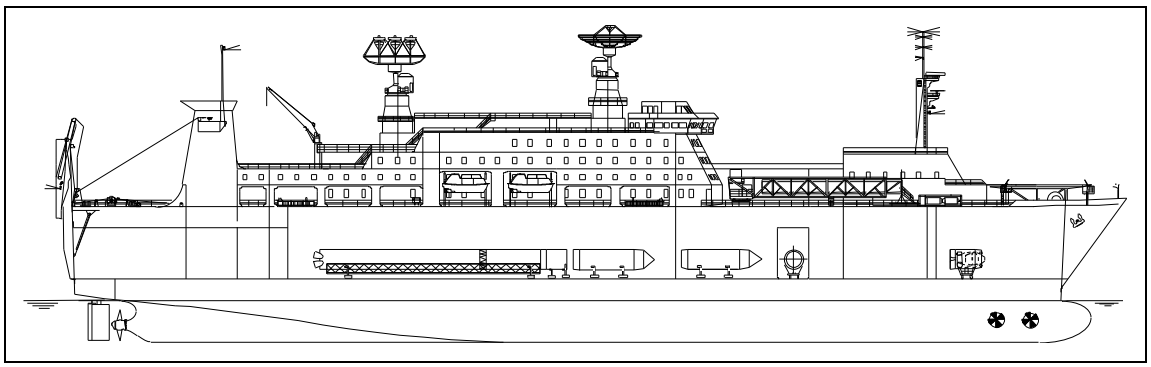

Figure A.2.1-1. Assembly & Command Ship

A.2.2 Launch Vehicle Integration Area

Launch vehicle stages will be loaded onboard the ACS in the Home Port through the stern ramp (Figure A.2.2-1). Processing and assembly of the stages will be conducted on the rail systems in the rocket assembly compartment on the main deck, accommodating parallel processing of up to three launch vehicles at one time. A special area in the bow of the main deck will be dedicated for processing and fueling of the Block DM-SL upper stage. Processing and assembly of the launch vehicle will typically done in port in parallel with spacecraft processing operations, but many of these operations may also be accomplished during transit to and from the launch location.

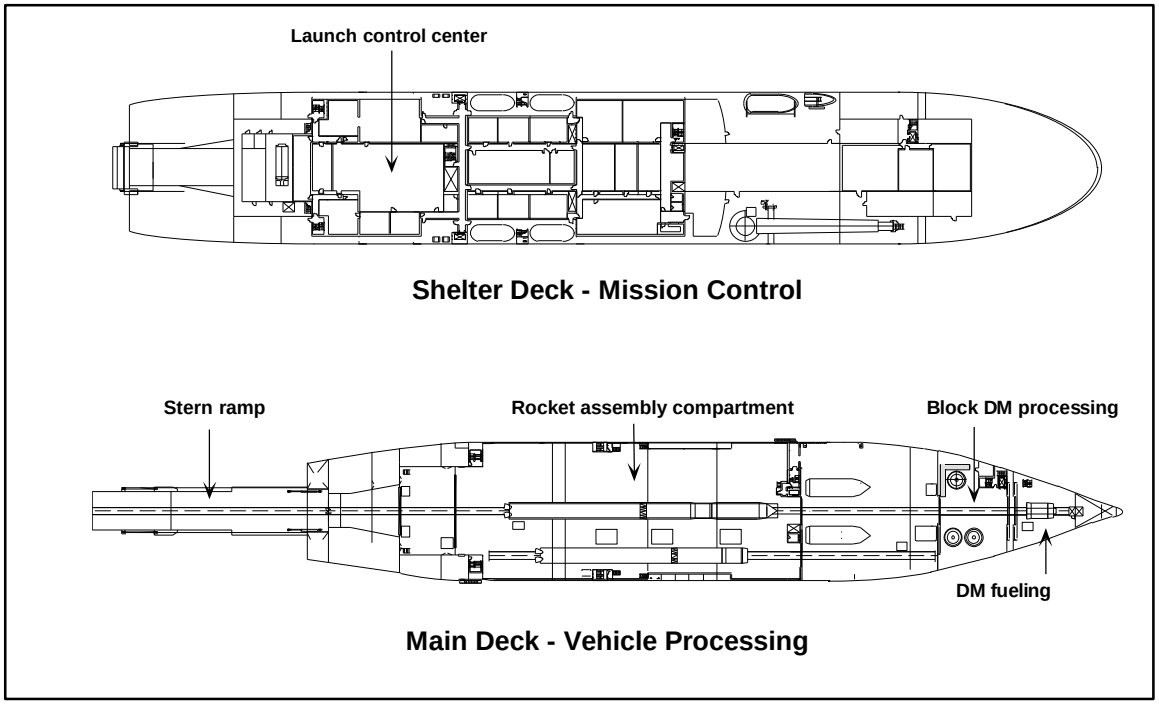

Figure A.2.2-1. Launch Vehicle Processing and Mission Control

A.2.2.1 Block DM-SL Fueling Process

Fueling of the upper stage will be accomplished onboard the ACS prior to mating with the first and second stages. This operation will be accomplished with the ship moored parallel to the pier which will also allow for easy personnel access. Normal ship evaluations and some limited launch support operations

will continue during the upper stage fueling operation. The systems supporting this operation will be installed in four compartments located below the shelter deck between frames 221 and 189 (Figure A.2.2-1).

The upper stage fueling compartment (DM fueling) will be located on the main deck between frames 221 and 203. An air lock is provided directly aft of this compartment (frames 203 to 201) to isolate this space from the adjacent assembly areas. Access to the DM fueling compartment will be provided by a large set of sliding doors in the bulkheads at frames 203 and 201 to allow movement of the upper stage through the air lock. These doors will be provided with gas tight seals to maintain the air lock seal. A personnel access door will be provided through the air lock bulkhead on the port side, outboard of the lift/stairwell. This door will also be provided with gas tight seals. The air lock will cover the complete bulkhead between the main deck and the shelter deck. Stuffing tubes and related seals will be provided for all penetrations through the air lock bulkheads. The DM fueling compartment will contain facilities to connect the fuel transfer lines to the upper stage fuel fitting.

Fuel equipment compartments will be provided between the tank top and the main deck between frames 213 and 189. The two compartments directly under the main deck (tween deck) will contain the fuel service system for the two hypergolic components: MMH and N_2O_4. The two compartments will provide complete separation of the fueling components. A change room will be located forward of each compartment, which will also serve as an air lock between the fuel equipment compartments and the companion way/stair well.

A separate ventilation system, designed to control the potential accidental release of toxic and explosive vapors during fueling operations, will be provided. The supply and exhaust ventilation systems will be balanced to maintain a lower atmospheric pressure in the hazardous areas. The design of a means of scrubbing hazardous vapors from the exhaust air will be developed to achieve zero release of MMH or N_2O_4. The exhaust from this system will be located near the top of the forward mast, approximately 13 m above the weather deck. This location will also provide additional dilution if any release were to escape.

A.2.2.2 Rocket Assembly Process

Assembly of the integrated launch vehicle includes assembly of the Zenit Stages 1 and 2 and their mating, mating of the Block DM-SL upper stage to the second stage of the Zenit, and mating of the payload unit to the Block DM-SL upper stage.

The Zenit stages will be prepared for assembly by removing protective covers and fixtures used for transportation/shipping and positioned on the center rail in the rocket assembly compartment (Figure A.2.2-1). The first and second stages will be properly aligned and mechanically mated; electrical and piping connections will then be mated and verified. The onboard control system will be tested through the use of a computer-controlled test system. The test software will be verified in the factory prior to use onboard the ACS. Electrical test equipment will use unique connectors to preclude improper connections. Pneumatic test equipment connections will also be of unique configurations. The propellant tanks and piping (liquid oxygen: 1.8 kgf/cm^2) and kerosene tanks (1st stage - 1.6 kgf/cm^2 and 2nd stage 1.5 kgf/cm^2) will be leak tested. The pressurant system's nitrogen and helium tanks are charged to 220 (+10/-5) kgf/cm^2 and the propellant control and flow systems are leak tested at 15 kgf/cm^2. The four retro rockets (stage separation SRMs) will be installed on each stage. The Block DM-SL upper stage will be mated to the assembled Zenit stages and electrical interface connectors will be verified.

The encapsulated payload will be loaded onto the ACS from land through the stern ramp. Once onboard, the encapsulated payload and its transportation dolly will be positioned on the center rail in the

rocket assembly compartment for integration with the launch vehicle. The payload unit will be mated to the Block DM-SL and interface electrical connections will be verified.

After the payload is integrated with the launch vehicle and all checkouts are complete, the integrated launch vehicle will be transferred to the launch platform. Environmental conditioning and monitoring of the encapsulated spacecraft is continuous from spacecraft encapsulation through launch. The only breaks are during transfer from stationary to mobile environmental conditioning units (less than three minites). Monitoring equipment will be mounted near the conditioned air exhaust from the spacecraft and upper stage.

A.2.2.3 Integrated Launch Vehicle Transfer from ACS to LP

Transfer of the ILV from the ACS assembly area to the LP hangar will be accomplished just prior to the LP departing the Home Port for the launch area. At this time, all other operations related to provisioning the LP and preparation of the ILV will have been completed. The following general sequence of operations will be accomplished to achieve the safe transfer:

1. The ACS will be moved from its portside berth and moored by its starboard side forward of the LP so both the ACS and LP centerlines are in a common straight line. The launch platform lies close to the pier, while the ACS has to be moored at some distance from the pier in order to be in centerline with the LP (Figure A.2.2-2).
2. The stern ramp will be lowered in horizontal position and a support cable system is attached between the end of the ramp and the LP. This support cable transfers some load from the ACS to the LP during the operation as well as supporting the stern ramp (Figure A.2.2-3).
3. Door and deck hatches in the front of the LP hangar will be opened and secured in the open position. The two LP hangar cranes will be moved into position to lift the ILV. Four guide cables will be installed (two on each side) between the ramp and the LP crane bridge. The guide cables will be kept taut by a tensioning system and will be used to guide and stabilize the ILV during hoisting.
4. The ILV and carriage will be moved out onto the ramp and positioned for lift. The ILV lifting equipment will be mounted on the rocket and prepared for connection to the LP crane hooks. The carriage prelift hydraulic system cylinders will now prepared to lift the ILV from the carriage.
5. The ILV lifting equipment includes transverse bars that will be attached to the crane hook. The ends will be equipped with rollers that attach to the guide cables and also to the hydraulic prelifting system. The transverse bars will be prepared for connection to the lifting crane hooks.
6. Both crane hooks will be lowered and connected to the lifting bars. Slack will be taken out of the crane lifting cables but no tension is applied at this time.
7. Hydraulic power will be applied to the prelifting cylinders and the ILV is lifted clear of the carriage to a predetermined height. Slack will be taken out of the crane lifting cables but no tension will be applied at this time.
8. Final checks for the lift operations will be accomplished. These include weather, the mooring arrangement, personnel on station, and ensuring that no other vessels are in positions which can lead to disturbances.

9. The ILV load will be transferred to the crane by lowering the prelifting cylinders.
10. The ILV will then hoisted by the cranes, which operate simultaneously to keep the rocket in a horizontal position, up to the level required to move it into the hangar. Once the ILV is at this level, the lifting bars will be released from the guiding rollers and the guide wires.
11. The ILV will then moved into the hangar position to be landed on the erector carriage.
12. The erector wagon will be moved into position under the ILV and the load will be lowered on to the erector carriage.
13. The ILV lifting equipment will be moved back to the carriage on the ACS stern ramp and the carriage will be moved into the assembly area.
14. The stern ramp will be released from the LP and both vessels will be readied for departure.